CLAIMS

1. A method of manufacturing a semiconductor light emitting device by growing nitride III-V compound semiconductor layers forming a light emitting device structure on a nitride III-V compound semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, comprising:

defining a device region on the nitride III-V compound semiconductor substrate such that the device region does not include the second regions substantially.

2. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the device region is determined in size and location such that the device region does not include the second regions substantially.

3. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the second regions align periodically.

4. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the second regions align periodically in form of hexagonal lattices.

5. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the second regions align periodically in form of rectangular lattices.

6. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the second regions align periodically in form of square lattices.

7. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the device region is rectangular.

8. The method of manufacturing a semiconductor light emitting device according to claim 7 wherein a pair of opposed sides of the device region are parallel to the <1-100> direction, and the other pair of opposed sides are parallel to the <11-20> direction.

9. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the device region is square.

10. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the interval between neighboring two of the second regions is 20 μm or more.

11. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the interval between neighboring two of the

second regions is 50 μm or more.

12. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the interval of neighboring two of the second regions is 100 μm or more.

13. The method of manufacturing a semiconductor light emitting device according to claim 3 wherein the period of alignment of the second regions is 20 μm or more.

14. The method of manufacturing a semiconductor light emitting device according to claim 3 wherein the period of alignment of the second regions is 50 μm or more.

15. The method of manufacturing a semiconductor light emitting device according to claim 3 wherein the period of alignment of the second regions is 100 μm or more.

16. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the second regions penetrate the nitride III-V compound semiconductor substrate.

17. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein each said second region has an arbitrary polygonal prismatic shape.

18. The method of manufacturing a semiconductor light emitting device according to claim

1 wherein third regions having a third average dislocation density higher than the first average dislocation density and lower than the second average dislocation density are interposed between the first region and the second regions.

19. The method of manufacturing a semiconductor light emitting device according to claim 18 wherein the device region is defined such that the device region does not include the second regions and the third regions substantially.

20. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein each said second region has a diameter from 10 to 100 μm.

21. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein each said second region has a diameter from 20 to 50 μm.

22. The method of manufacturing a semiconductor light emitting device according to claim 18 wherein each said third region has a diameter larger than the diameter of each said second region by a value from 20 to 200 μm.

23. The method of manufacturing a semiconductor light emitting device according to claim 18 wherein each said third region has a diameter larger than the diameter of each said second region by a value

from 40 to 160 μm.

24. The method of manufacturing a semiconductor light emitting device according to claim 18 wherein each said third region has a diameter larger than the diameter of each said second region by a value from 60 to 140 μm.

25. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the average dislocation density of the second regions is five times or more.

26. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the average dislocation density of the second regions is $1\times10^{8}cm^{-2}$ or more.

27. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the average dislocation density of the first region is $2\times10^{6}cm^{-2}$ or less, and the average dislocation density of the second regions is $1\times10^{8}cm^{-2}$ or more.

28. The method of manufacturing a semiconductor light emitting device according to claim 18 wherein the average dislocation density of the first region is $2\times10^{6}cm^{-2}$ or less, the average dislocation density of the second regions is $1\times10^{8}cm^{-2}$ or more, and the average dislocation density of the third regions is lower than $1\times10^{8}cm^{-2}$ and higher than $2\times10^{6}cm^{-2}$.

29. The method of manufacturing a

semiconductor light emitting device according to claim 1 wherein the emission region of the semiconductor light emitting device is distant from the second regions by at least 1 μm.

30. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the emission region of the semiconductor light emitting device is distant from the second regions by at least 10 μm.

31. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the emission region of the semiconductor light emitting device is distant from the second regions by at least 100 μm.

32. The method of manufacturing a semiconductor light emitting device according to claim 18 wherein the emission region of the semiconductor light emitting device does not include the second regions and the third regions.

33. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein a region supplied with a drive current through a stripe-shaped electrode in the semiconductor light emitting device is distant from the second regions by at least 1 μm.

34. The method of manufacturing a semiconductor light emitting device according to claim

1 wherein a region supplied with a drive current through a stripe-shaped electrode in the semiconductor light emitting device is distant from the second regions by at least 10 μm.

35. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein a region supplied with a drive current through a stripe-shaped electrode in the semiconductor light emitting device is distant from the second regions by at least 100 μm.

36. The method of manufacturing a semiconductor light emitting device according to claim 18 wherein a region supplied with a drive current through a stripe-shaped electrode in the semiconductor light emitting device does not include the second regions and the third regions.

37. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein border lines of the device region includes a straight line connecting at least neighboring two of said second regions.

38. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the nitride III-V compound semiconductor substrate having the nitride III-V compound semiconductor layers grown thereon is diced along border lines including at least neighboring two of the

second regions.

39. The method of manufacturing a semiconductor light emitting device according to claim 38 wherein the dicing is carried out by cleavage.

40. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein border lines of the device region are distant from the second regions by at least 1 μm.

41. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the nitride III-V compound semiconductor substrate having the nitride III-V compound semiconductor layers grown thereon is diced along border lines distant from the second regions by at least 1 μm.

42. The method of manufacturing a semiconductor light emitting device according to claim 41 wherein the dicing is carried out by cleavage.

43. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the nitride III-V compound semiconductor substrate is made of $Al_xB_yGa_{1-x-y-z}In_zAs_uN_{1-u-v}P_v$ (where $0 \le x \le 1$, $0 \le y \le 1$, $0 \le z \le 1$, $0 \le u \le 1$, $0 \le v \le 1$, $0 \le x+y+z < 1$ and $0 \le u+v < 1$).

44. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the nitride III-V compound semiconductor

substrate is made of $Al_xB_yGa_{1-x-y-z}In_zN$ (where $0 \le x \le 1$, $0 \le y \le 1$, $0 \le z \le 1$ and $0 \le x+y+z < 1$).

45. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the nitride III-V compound semiconductor substrate is made of $Al_xGa_{1-x-z}In_zN$ (where $0 \le x \le 1$ and $0 \le z \le 1$).

46. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the nitride III-V compound semiconductor substrate is made of GaN.

47. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the semiconductor light emitting device is a semiconductor laser.

48. The method of manufacturing a semiconductor light emitting device according to claim 1 wherein the semiconductor light emitting device is a light emitting diode.

49. A semiconductor light emitting device manufactured by:

growing nitride III-V compound semiconductor layers forming a light emitting device structure on a nitride III-V compound semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region

made of a crystal and having the first average dislocation density; and

dicing the nitride III-V compound semiconductor substrate having the nitride III-V compound semiconductor layers grown thereon along border lines including at least neighboring two of the second regions.

50. A semiconductor light emitting device including nitride III-V compound semiconductor layers grown to form a light emitting device structure on a nitride III-V compound substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, in which at least one of said second regions resides on an end surface or a corner of the nitride III-V compound semiconductor substrate.

51. A method of manufacturing a semiconductor device by growing nitride III-V compound semiconductor layers forming a device structure on a nitride III-V compound semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, comprising:

defining a device region on the nitride III-V compound semiconductor substrate such that the device region does not include the second regions substantially.

52. A semiconductor device manufactured by:

growing nitride III-V compound semiconductor layers forming a device structure on a nitride III-V compound semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density; and

dicing the nitride III-V compound semiconductor substrate having the nitride III-V compound semiconductor layers grown thereon along border lines including at least neighboring two of the second regions.

53. A semiconductor device including nitride III-V compound semiconductor layers grown to form a device structure on a nitride III-V compound semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, in which at least one of said second regions resides on an end surface or a corner of the nitride III-V compound

semiconductor substrate.

54. A method of manufacturing a semiconductor light emitting device by growing semiconductor layers forming a light emitting device structure on a semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, comprising:

defining a device region on the semiconductor substrate such that the device region does not include the second regions substantially.

55. A semiconductor light emitting device manufactured by:

growing semiconductor layers forming a light emitting device structure on a semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density; and

dicing the semiconductor substrate having the semiconductor layers grown thereon along border lines including at least neighboring two of the second regions.

56. A semiconductor light emitting device

including semiconductor layers grown to form a light emitting device structure on a semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, in which at least one of said second regions resides on an end surface or a corner of the semiconductor substrate.

57. A method of manufacturing a semiconductor device by growing semiconductor layers forming a device structure on a semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, comprising:

defining a device region on the semiconductor substrate such that the device region does not include the second regions substantially.

58. A semiconductor device manufactured by:

growing semiconductor layers forming a device structure on a semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average

dislocation density; and

dicing the semiconductor substrate having the semiconductor layers grown thereon along border lines including at least neighboring two of the second regions.

59. A semiconductor device including semiconductor layers grown to form a device structure on a semiconductor substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, in which at least one of said second regions resides on an end surface or a corner of the semiconductor substrate.

60. A method of manufacturing a device by growing layers forming a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, comprising:

defining a device region on the substrate such that the device region does not include the second regions substantially.

61. A device manufactured by:

growing layers forming a device structure on a substrate in which a plurality of second regions

having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density; and

dicing the substrate having the layers grown thereon along border lines including at least neighboring two of the second regions.

62. A device including layers grown to form a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, in which at least one of said second regions resides on an end surface or a corner of the substrate.

63. A method of manufacturing a device by growing layers forming a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, comprising:

defining a device region on the substrate such that an active region of the device does not include the second regions.

64. The method of manufacturing a device according to claim 63 wherein the substrate is a

nitride III-V compound semiconductor substrate and the device is a semiconductor light emitting device.

65. A device including layers grown to form a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, in which at least one of said second regions resides inside the substrate or on an end surface or a corner of the substrate, and an active region of the device does not include the second regions.

66. A device according to claim 65 wherein the substrate is a nitride III-V compound semiconductor substrate and the device is a semiconductor light emitting device.

67. A method of manufacturing a device by growing layers forming a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density regularly align in a first region having the first average dislocation density in first intervals in a first direction and in second intervals smaller than the first intervals in a second direction normal to the first direction, comprising:

defining a device region on the substrate

such that the device region does not substantially include seven or more rows of the second regions in the second direction, and an active region of the device does not include the second regions.

68. The method of manufacturing a device according to claim 67 wherein the substrate is a nitride III-V compound semiconductor substrate and the device is a semiconductor light emitting device.

69. A device manufactured by growing layers forming a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density regularly align in a first region having the first average dislocation density in first intervals in a first direction and in second intervals smaller than the first intervals in a second direction normal to the first direction, in which the substrate does not substantially include seven or more rows of the second regions and an active region of the device does not include the second regions.

70. The device according to claim 69 wherein the substrate is a nitride III-V compound semiconductor substrate and the device is a semiconductor light emitting device.

71. A method of manufacturing a device by growing layers forming a device structure on a substrate in which a plurality of second regions having

a second average dislocation density higher than a first average dislocation density regularly align in a first region having the first average dislocation density in first intervals in a first direction and in second intervals smaller than the first intervals in a second direction normal to the first direction, comprising:

defining a device region on the substrate such that the first interval is 50 μm or more, one or more rows of the second regions in the second direction are included, and an active region of the device does not include the second regions.

72. The method of manufacturing a device according to claim 71 wherein the substrate is a nitride III-V compound semiconductor substrate and the device is a semiconductor light emitting device.

73. A device manufactured by growing layers forming a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density regularly align in a first region having the first average dislocation density in first intervals in a first direction and in second intervals smaller than the first intervals in a second direction normal to the first direction, in which the first interval is 50 μm or more, one or more rows of the second regions in the second direction is included, and

an active region of the device does not include the second regions.

74. The device according to claim 73 wherein the substrate is a nitride III-V compound semiconductor substrate and the device is a semiconductor light emitting device.

75. A method of manufacturing a device by growing layers to form a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density and extending linearly align regularly in parallel to each other in a first region made of a crystal having the first average dislocation density, comprising:

defining a device region not to include seven or more of the second regions and not to include the second regions in an active region of the device.

76. The method of manufacturing a device according to claim 75 wherein the substrate is a nitride III-V compound semiconductor substrate and the device is a semiconductor light emitting device.

77. A device manufactured by growing layers forming a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average

dislocation density, in which the device region does not substantially include seven or more rows of the second regions in the second direction, and an active region of the device does not include the second regions.

78. A device according to claim 77 wherein the substrate is a nitride III-V compound semiconductor substrate and the device is a semiconductor light emitting device.

79. A method of manufacturing a device by growing layers to form a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density and extending linearly align regularly in parallel to each other in a first region made of a crystal having the first average dislocation density, comprising:

defining a device region such that the interval of the second regions is 50 μm or more, one or more of the second regions are included, and an active region of the device does not include the second regions.

80. The method of manufacturing a device according to claim 79 wherein the substrate is a nitride III-V compound semiconductor substrate and the device is a semiconductor light emitting device.

81. A device manufactured by growing layers

forming a device structure on a substrate in which a plurality of second regions having a second average dislocation density higher than a first average dislocation density align regularly in a first region made of a crystal and having the first average dislocation density, in which the interval of the second regions is 50 μm or more, one or more of the second regions are included, and an active region of the device does not include the second regions.

82. A device according to claim 81 wherein the substrate is a nitride III-V compound semiconductor substrate and the device is a semiconductor light emitting device.